CHEMICALS

Project Fact Sheet

Ceramic Membrane Process for Upgrading Vacuum Residual Oil

Benefits

- Reduces energy costs by 50 percent compared to conventional processes
- Recovers premium catalytic cracking feedstocks from residual oil
- Saves on solvent recovery costs

Applications

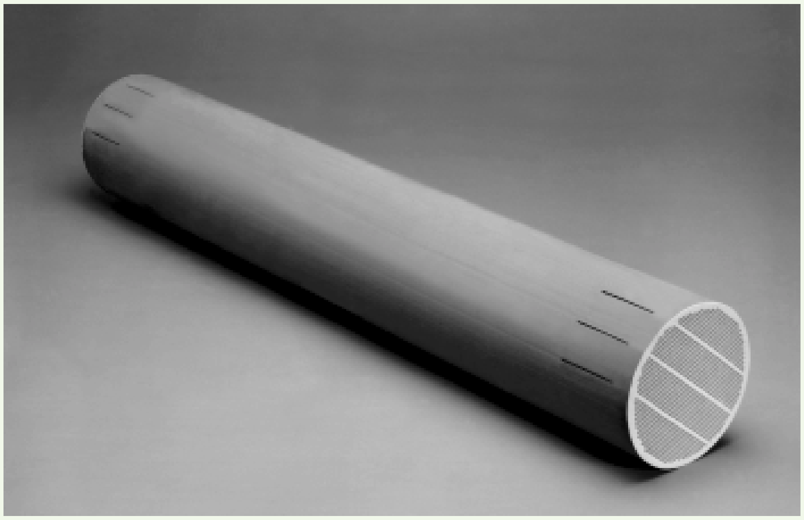
This technology provides a convenient way for petrochemical refiners to skim off a small to large fraction of material suitable as catalytic cracker feedstock from residual oil. This purified material will be substantially reduced in metals and coke-forming species for a fraction of the cost of conventional technologies. The technology's flexibility allows it to be used on even the heaviest of crudes, tar sands and bitumen, and atmospheric and vacuum residuals, to recover valuable hydrocarbons that might otherwise be converted to coke and gas.

New technology gives refiners a more efficient heavy oil upgrading option

The world's supply of recoverable light crudes and those having low concentrations of sulfur and contaminant metals is quickly decreasing. Despite this decline in the availability of quality crude oil feedstocks, the specifications of the products into which crude oils are made (gasoline, fuel oil, diesel, etc.) remain the same or have become more stringent. These factors have led to an increase in the amount of "bottom of the barrel," residual oils being produced. Project partners are developing a low-cost membrane process for upgrading residual oils to more valuable products.

The preferred process for purifying residual oils is solvent deasphalting (SDA). In SDA, the residual oil is divided into two fractions: a fraction formed of asphaltenes and containing the major part of the contaminant metals, and a fraction formed of deasphalted oil, which contains the resins, aromatics, and saturates. Asphaltenes and contaminant metals must be removed in order to avoid poisoning and fouling of catalysts in catalytic upgrading processes. SDA entails the precipitation of the asphaltenes by the addition of low-polarity hydrocarbons to the residual. The membrane deasphalting/demetallizing process being developed by the project partners is based on the SDA process, but will use one-tenth of the solvent needed for conventional SDA, resulting in significantly reduced capital and energy costs.

Membrane for Residual Oil Upgrade



Prototype ceramic ultrafiltration module (5.66 inches in diameter, 34 inches long, 120 sq. ft. of membrane area).

Project Description

Goal: The goal of this project is to develop a process that uses an inorganic membrane to achieve separation between the high metal/high coke-forming asphaltene fraction and the lower metal/lower coke-forming deasphalted oil fraction of heavy crudes and residual oils.

Conventional solvent deasphalting (SDA) units require solvent-to-feed ratios ranging from 8 to 11. Recovery of this solvent is necessary from an economic standpoint and requires significant energy. Project partners are developing a process in which a small amount of a diluent (which may or may not be a standard deasphalting solvent) is added to a residual oil. The resulting mixture is treated by ceramic ultrafiltration membranes at temperatures up to 200°C. Early research has shown solvent-to-feed ratios of 0.5 to 1 are feasible and should result in a savings of more than 50 percent of the energy costs required to recover the solvent in conventional SDA. Ultrafiltration at elevated temperatures is possible due to the novel lost-cost inorganic membranes being developed.

Progress and Milestones

The following are technical objectives that were achieved in the initial stages of research:

- Demonstrated that ultrafiltration of heavy oils can be carried out at solvent to feed ratios less than one
- Demonstrated permeate quality substantially equal to that of deasphalted oil from pentane deasphalting
- Demonstrated flux approaching that required for commercial feasibility

Current research is focused on achieving the following milestones:

- Select and characterize four feeds of commercial interest to partners
- Perform process development studies in batch, stirred cells to quickly isolate the most important factors in residual oil ultrafiltration
- Construct and operate a stages-in-series pilot plant with selected feed to demonstrate continuous operation
- Complete an 800-hour life test to demonstrate stability of membranes

Project Partners

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Trans ionics Corporation
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